Before Roundup Ready Crops: Was Weed Control that Great?

Steve Wright, University of California Cooperative Extension, Tulare & Kings Counties,
4437B S. Laspina St., Tulare, CA 93274, sdwright@ucdavis.edu

Roundup Ready technology has provided California cotton, corn, and alfalfa growers with an excellent tool for managing many annual and perennial weeds. Some of the advantages to this system include the following: 1) Glyphosate can be applied postemergence so growers can wait and see the weeds present. 2) There are no plant-back restrictions. 3) Glyphosate has a wide spectrum of weed control controlling or suppressing many annuals and perennials. This technology, used in conjunction with other herbicide programs when needed, has allowed growers to reduce hand hoeing and cultivation. Hand weeding costs varied from $25 to $150 per acre depending on weed species and density.

Prior to the use of glyphosate tolerant crops the most common and difficult to control weeds in agronomic crops were nightshades, both hairy (Solanum sarrachoides) and black (S. Nigrum L.), and annual morningglory (Ipomoea spp.), that infested hundreds of thousands of acres. Perennial weeds were a problem in most fields. Nutsedge species including yellow (Cyprerus esculentus L.) and purple nutsedge (*C rotundus L.*) were the most difficult to control. Other perennial weed problems included field bindweed (*Convolvulus arvensis L.*), and to a lesser extent bermudagrass (*Cynodon dactylon L.*) and Johnsongrass (Sorghum halepense).

Mechanical Control

Weed control was easier in properly prepared fields that were not already infested with perennial weeds or difficult to control annuals. Perennials were often less expensive and easier to control in fallow fields or in certain rotation crops. Summer fallow was sometimes used to reduce purple nutsedge populations. Tubers are then destroyed with repeated summer tillage of dry soil. A spring-tooth harrow is the best tool for this. This is effective for purple nutsedge control because the tubers are susceptible to desiccation. However, dry fallow is not effective for control of yellow nutsedge because the tubers can survive up to 4 years in dry soil. Nutsedge was controlled more effectively with preplant incorporated herbicides in corn, tomatoes, or sugar beets than in cotton. Presently with glyphosate tolerant crop technology it has been so effective that it's now difficult to even to find an infested field today.

Deep plowing to bury seeds and other reproductive organs, such as tubers, can still be an effective method of reducing weed populations. A modified moldboard plow known as a Kverneland plow, that inverts the soil 180 degrees, has been used effectively to reduce nightshade populations. This plow has been effective at reducing yellow nutsedge tubers in the top of the soil profile. By burying the tubers at least nine inches deep, nutsedge may be suppressed for 4 to 6 weeks. Purple nutsedge that emerges from deeper in the soil profile is more difficult to control.

Despite the benefits of herbicides, mechanical cultivation was then and is still one of the most important weed control methods. Cultivation is often used to remove weeds not controlled with preplant herbicides. Growers typically used rolling cultivators to control weeds and reshape beds

for planting. The use of a sweep in the middle of the bed was used to cut off emerging nutsedge; without this strategy, nutsedge can emerge before cotton and deplete the soil moisture, thereby hampering cotton emergence and seedling growth. Rolling cultivators are effective to control annual weeds, whereas, sweep-type cultivators are more effective for uprooting perennial grasses, nutsedge, and morningglories.

Preplant Incorporated Herbicides (PPI)

Dinitroanilines, trifluralin and pendimethalin, are still widely used soil-applied, residual herbicides. These herbicides are effective against most annual grasses and many broadleaf annuals; however, nightshade, mustards, and annual morningglories are not controlled by these herbicides. A tank-mix application of prometryn with trifluralin or pendimethalin just before planting, provided effective control of both hairy and black nightshades when adequate soil moisture was present. Cotton safety was compromised if rainfall moved prometryn into the root zone.

A soil fumigant, metham sodium was effective for weed control in nightshade infested fields. This treatment can suppress nutsedge for 4 to 6 weeks following application. Metham was applied in various ways; the best results in cotton were obtained when metham was applied to preformed beds with a spray blade 3 to 4 inches below the soil surface and then covered (capped) with a 2- to 3-inch layer of soil.

Postemergence Herbicides

Several postemergence herbicides are available for weeds that are not controlled by preplant or at-planting herbicide applications. Herbicides for postemergent use on cotton include sethoxydim (Poast), fluazifop - P (Fusilade), clethodim (Prism), MSMA, and pyrithiobac sodium (Staple). Nightshade control with Staple has been excellent. Best results are obtained when Staple is applied early post emergence over the top of cotyledon to 4-leaf cotton when nightshade is in the cotyledon to 2 - 4 leaf stage. Staple causes slight yellowing and crinkling of cotton leaves 4 to 7 days after application but symptoms are nonexistent 21 days and there is no significant yield reduction.

MSMA was commonly used for heavy stands of nutsedge where close cultivation is insufficient. It was applied over the top of seedling cotton less than 3 inches in height and/or post directed to the base of the cotton plants prior to the flowing stage. MSMA is about twice as effective when temperatures are 90 F. rather than 75 F.

Grassy weeds including Johnsongrass, barnyardgrass, and bermudagrass were controlled with clethodim, sethoxydim or fluazifop-P. Johnsongrass control has been excellent but, bermudagrass control has been limited unless treatment occurs soon after an irrigation or rain. Retreatment is always necessary. Tank-mix combinations of some grass herbicides with Staple herbicide may result in reduced grass control.

A postemergence-directed application cyanazine, prometryn, or oxyfluorfen can kill small annual morningglory and nightshade. Broadleaf weeds should be at the small-seedling stage with no more than two to three true leaves for effective control. Glyphosate was sometimes used for controlling

field bindweed with a hooded sprayer or for spot treating perennial grasses. A sled-mounted or a shielded sprayer minimized the likelihood of crop injury. These postemergence-directed herbicides were also applied at layby (final cultivation as cotton closes the furrow) to prevent weeds at harvest.

Herbicide tolerant corn hybrids using glyphosate and other herbicides such as Liberty Link are effective technologies for corn growers, who often can reduce tillage, reduce fuel costs, and use conservation tillage systems. In Roundup Ready cropping systems, weed shifts and weed resistance occurs. Weed shifts are usually associated with reduced tillage systems and not rotating herbicides. A major concern is the development of resistance to glyphosate by lambsquarter, amaranth, horseweed, junglerice and Italian ryegrass in California. Rotating glyphosate-resistant corn with another glyphosate-resistant crop such as cotton or alfalfa will increase the chances of developing herbicide resistant weeds. To help prevent the development of herbicide-resistant weeds and prevent weed shifts from occurring, it is crucial to incorporate tillage into the weed management practices as well as alternating herbicides that have different modes of action. There is still a place for some of the older herbicides. There are many herbicide options available for growers

The following herbicides are used in corn:
Pre-Plant: Atrazine, Aatrex, Eradicane, Sutan, Roundup, Dual Magnum, Outlook, Gramoxone Inteon, Micro-Tech

At Planting: Micro-Tech, Aatrex, Atrazine, Dual Magnum, Roundup, Gramoxone Inteon, Eradicane

After Planting: Accent, Prowl, glyphosate, 2,4-D, Banvel, Clarity, Distinct, Buctril, Gramoxone Inteon, Sencor, Aatrex, Atrazine, Sandea, Shark, Yukon, Option, Outlook, Matrix (rimsulfuron).

An over-the-top application can be used, but some products or tank mixes require a directed spray on corn larger than 8 to 12 inches in height to keep the herbicide out of the whorl and to minimize the risk of corn injury. Postemergent herbicides commonly used in corn include 2,4-D, bromoxynil (Buctril), carfentrazone (Shark), dicamba (Clarity), dicamba/halsulfuron (Yukon), diflufenzopyr (Distinct), halosulfuron (Sandea), metribuzin (Sencor), nicosulfuron (Accent), and foramsulfuron (Option), Matrix (rimsulfuron). It is important, however, to pay close attention to application guidelines on the labels to avoid phytotoxicity to the crop, especially with carfentrazone (Shark).

Cultural Practices
There is no single best weed control program for all growing conditions. A vigorous, competitive crop produced through proper seedbed preparation, variety selection, seeding rates, fertilization, irrigation, cultivation, pest control, and crop rotation is the best defense against problems. A well-managed corn crop is extremely competitive with most weeds. Good cultural practices combined with timely cultivations often control weeds sufficiently to maximize yields and profit without the use of an herbicide.

Cultivation is an effective weed control method in corn. Corn should be cultivated soon after weed emergence; shallow cultivation can kill weeds without disturbing the crop if proper soil conditions exist. Shovel or sweep-type cultivators can be used later in the season if necessary. Tools used for early cultivation are the rotary hoe and the rotary cultivator. Cultivating with sweeps can significantly reduce Johnsongrass, nutsedge, and bermudagrass between rows, but weeds in the crop row may require other control practices. Corn plants taller than 8 inches have roots that extend well into the furrow. Rolling cultivators cause less root pruning than sweeps or knives, but are less effective on nutsedge, Johnsongrass, and bermudagrass. Staying at least 4 inches from the corn and throwing soil to the plant can minimize root pruning.

The herbicide tolerant systems in cotton and corn has reduced weed control costs and given growers greater flexibility. This has allowed growers to explore alternative production systems such as conservation or reduced tillage, double row configurations, and ultra-narrow row systems. The potential for herbicide resistance should receive serious and thoughtful attention. As weed management systems change with new herbicides and herbicide resistant crops are introduced, resistant management must be an integral part of the production system. This integrated weed management system supplements an existing transgenic or conventional weed control program and uses a variety of the available pre-plant, selective over-the-top and layby herbicides along with tillage.

Many of the old techniques still have a place. Keep in mind many of the weeds were not being easily controlled before herbicide tolerant technology was available. There were many herbicides, spray timings and yet still lots of weeds.

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